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Lab. Project 9300-44
Technical Memorandum No. 6
SF 020-01-02, W.U. 3406

**FATIGUE PROPERTIES
OF
UNCOATED AND GALVANIZED
IMPROVED PLOW STEEL WIRES**

Maturoa; Sciences Division

16 June 1967



**U. S. NAVAL APPLIED SCIENCE LABORATORY
BROOKLYN, NEW YORK**



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Approved: 

Associate Technical Director

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Ref: (a) NAVAPLSCIENLAB Program Summary of 1 Nov 1966, SF 020-01-02,
Task 3406; Wire Rope and Fittings.

- Figs: (1) Photo L21096-5, Model 802, Hunter Spring, Rotating Beam Wire
Fatigue Tester.
(2) Procedure For Setting-Up Wire Specimens In Rotating Beam Wire
Fatigue Tester
(3) Results Of Fatigue Tests On Various Wire Specimens
(4) Comparison of S-N Curves For Various Wire Specimens

1. In accordance with reference (a), the U.S. Naval Applied Science Laboratory is conducting an investigation on corrosion resistant, high strength, wire rope suitable for use in marine environment applications. As part of this program, fatigue evaluations on uncoated and galvanized improved plow steel (I.P.S.) wires were conducted in a rotating beam wire fatigue tester. The objective of this work was to determine if data obtained in the wire fatigue tester could be useful in connection with wire rope investigations conducted at NASL.

2. A Model 802, Hunter Spring, rotating beam wire fatigue tester, shown on Figure (1), was used for the evaluations. The tester consists essentially of a motor-driven chuck and a magnetic bushing that is mounted in anyone of nine equally spaced holes in a bushing-bar. A micrometer screw is provided on the bushing-bar for accurately adjusting the distance between the chuck and bushing. Details of the procedures for setting-up and testing wire specimens in the fatigue tester are given on Figure (2). Formulas for determining the specimen length and chuck to bushing distance, appropriate to the testing stress desired, are also given on Figure (2). When set-up in the tester, the wire specimen assumes the shape of an arch in which the length is 2.19 times the base, the height is 0.835 times the base and the radius of curvature at the apex is 0.417 times the base.

3. Fatigue evaluations were conducted on 0.020 and 0.030 inch diameter uncoated I.P.S. wires and on 0.020 and 0.023 inch diameter drawn galvanized I.P.S. wires, which were obtained from a single source. At least three specimens, for each type and size of wire, were tested to failure at each of nine different stress levels, except where specimens did not fail after 10 million cycles. In these cases, only two specimens were evaluated.

4. Fatigue data obtained on the various wire specimens are shown plotted on Figure 3. A curve, faired in by eye, is fitted through the data points for each type and size of wire. The four S-N curves are redrawn on Figure 4 for purposes of comparison. It may be seen from the figure that for uncoated and galvanized wires of the same diameter, the fatigue life of the uncoated wire is appreciably longer. It may also be seen that, for 0.020 and 0.030 inch diameter uncoated wires, the fatigue life of the smaller diameter wire is appreciably longer. No valid comparison can be made from the S-N curves for the 0.020 and 0.023 inch

diameter galvanized wires due to the small difference in wire size. However, these curves do substantiate, to some extent, the trend observed for the uncoated wires, in that the smaller diameter wires appear to have a longer fatigue life than the larger diameter wires.

5. The above results indicate that relative fatigue properties of different wires can be determined in the rotating beam wire fatigue tester. This type of information could be useful in connection with endurance life evaluations conducted in the NASL wire rope fatigue machine, where ropes are subjected to combined fatigue and wear. When a rope exhibits a short endurance life during these evaluations, it would be desirable to determine whether the rope failed primarily from fatigue or wear. This determination could be made from tests, in the rotating beam wire fatigue tester, on sample wires from the rope and on wires from a rope that exhibited a long endurance life. A comparison of the results obtained from both ropes would indicate whether or not the short endurance life of the rope was primarily due to fatigue. In order to obtain background information in this regard, the Laboratory is planning to conduct tests in the rotating beam wire fatigue tester on sample wires from future ropes evaluated in the NASL wire rope fatigue machine.

6. Comparative evaluations of improved plow steel wire ropes with polypropylene and natural fiber cores are now being conducted and results will be reported by August 1967.

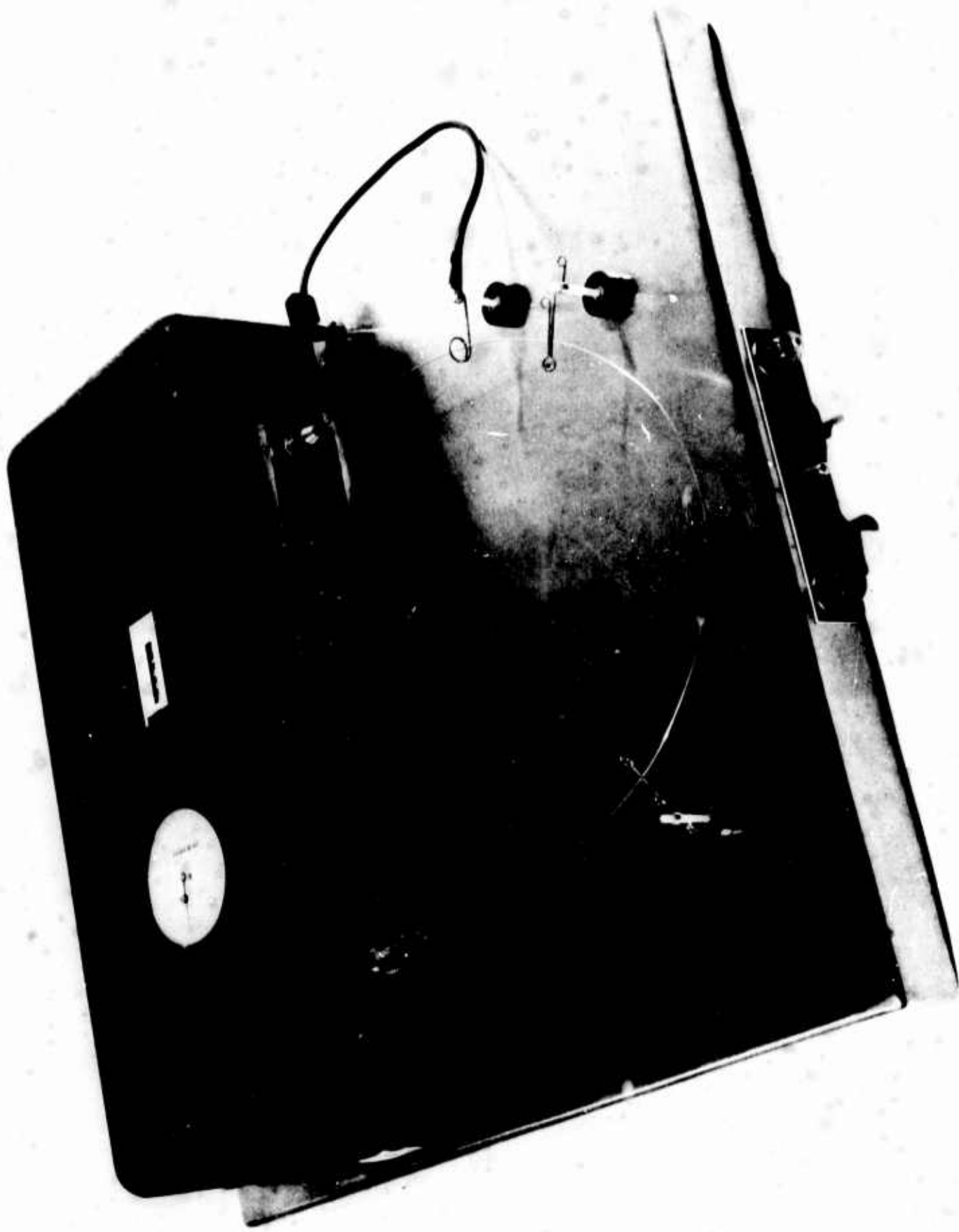


PHOTO L 21096-5

FIGURE 1—MODEL 802, HUNTER SPRING, ROTATING BEAM WIRE FATIGUE TESTER

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LAB PROJECT 9300-44
TECHNICAL MEMORANDUM 6

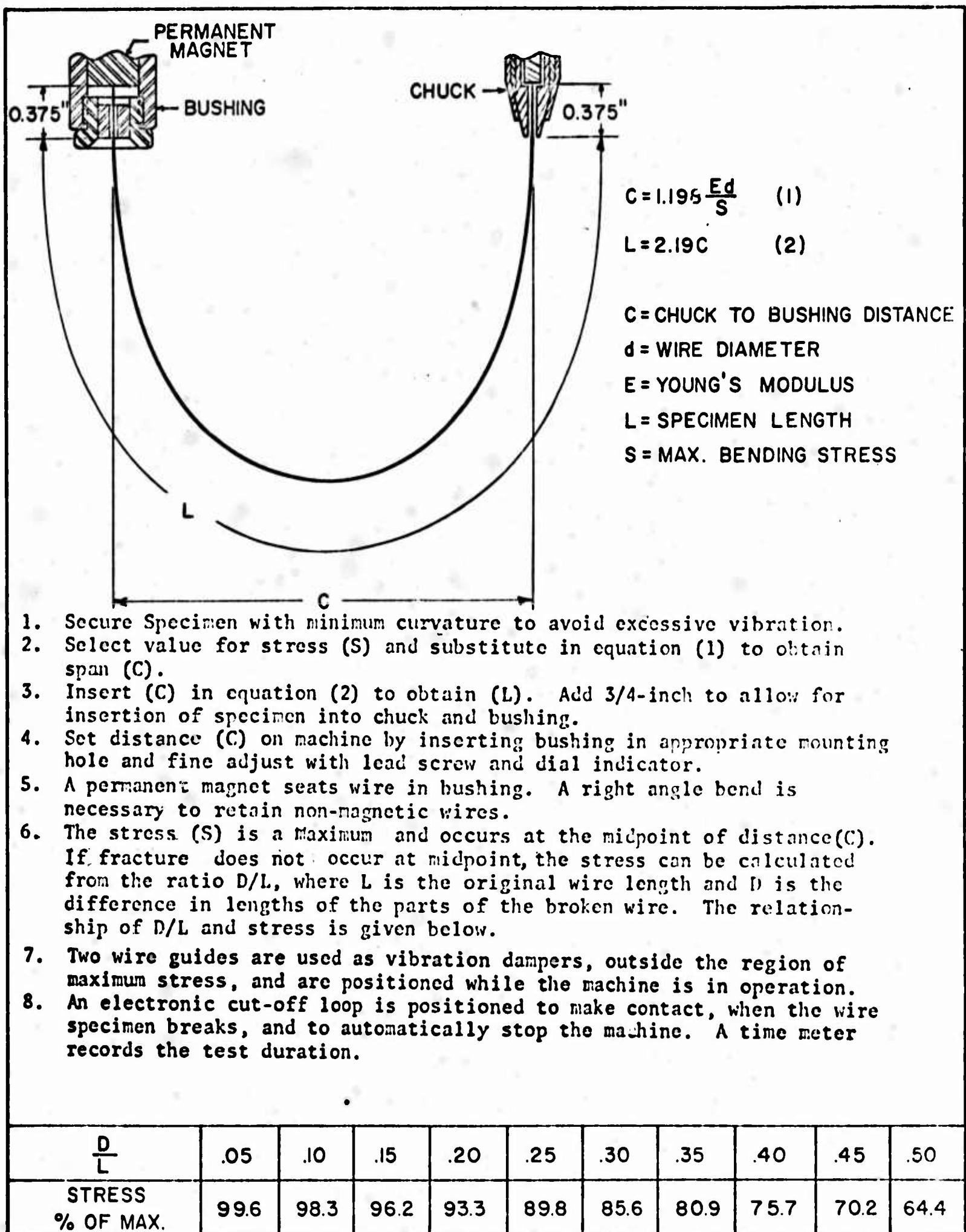


FIGURE 2 - PROCEDURE FOR SETTING UP WIRE SPECIMEN
IN MODEL 802 ROTATING BEAM WIRE FATIGUE TESTER

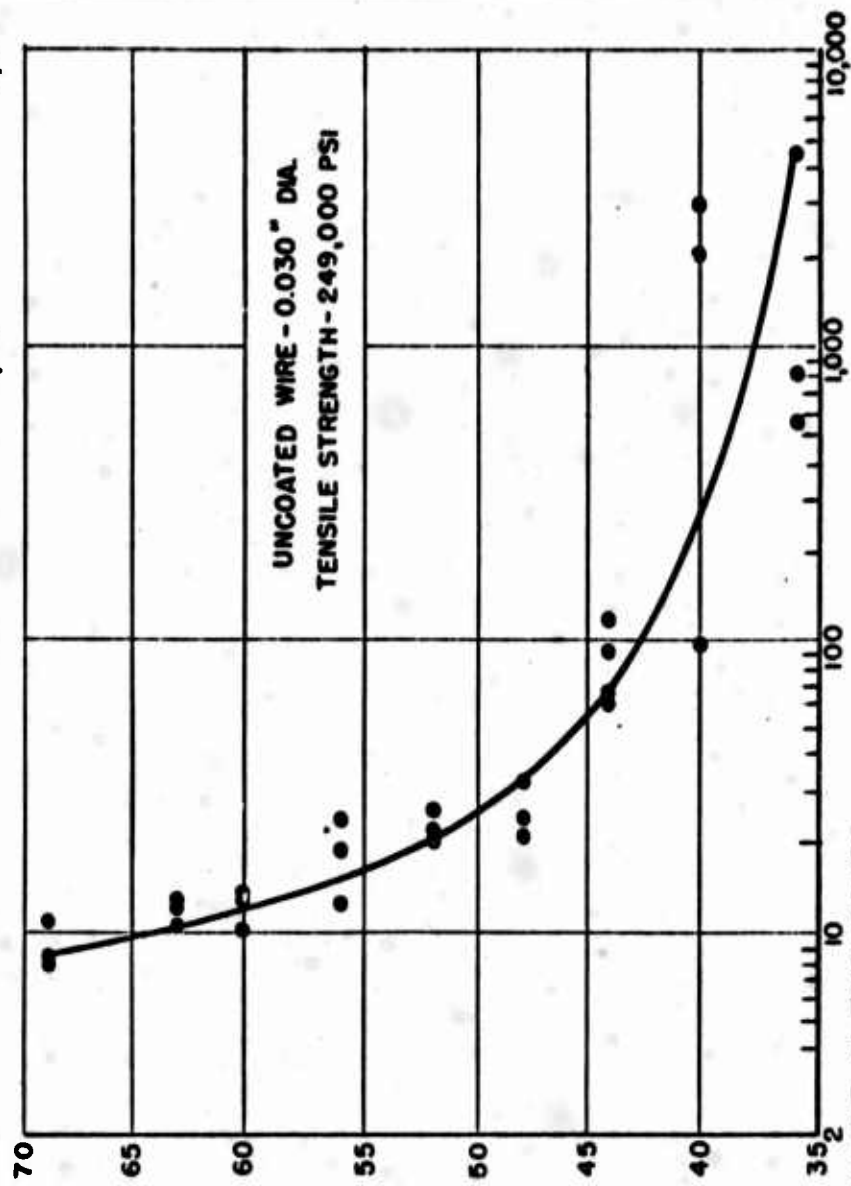
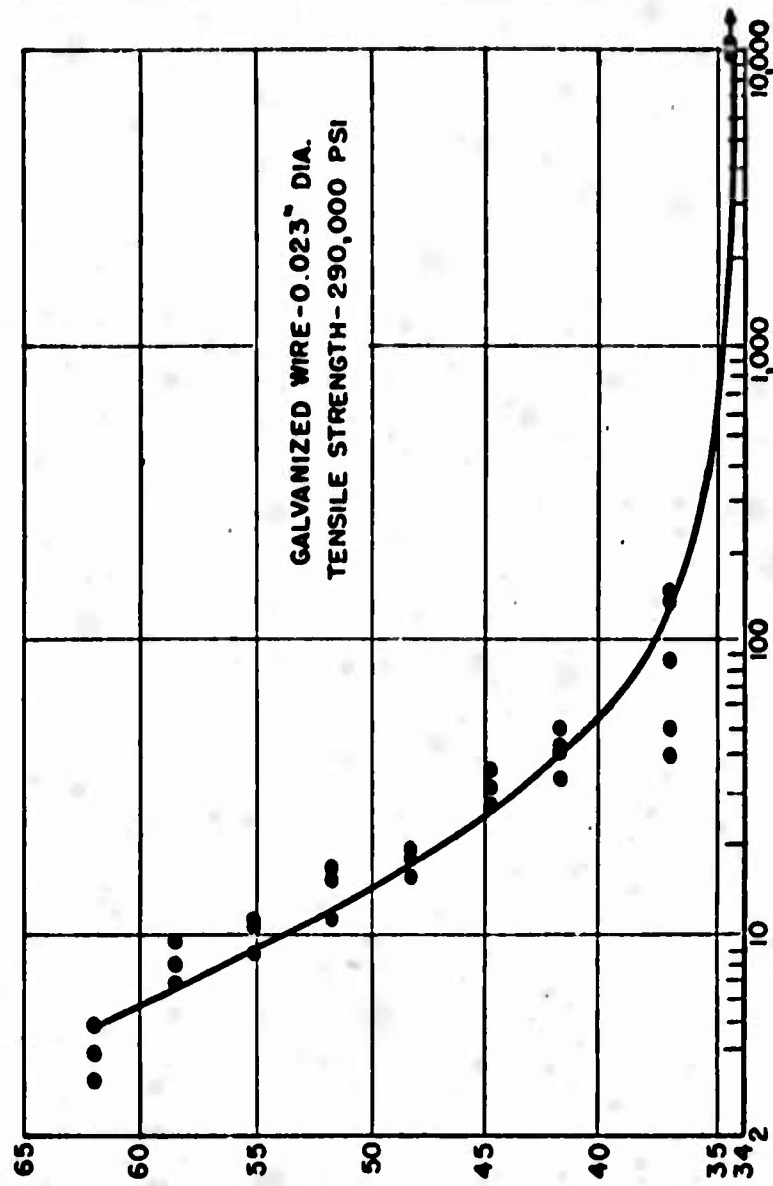
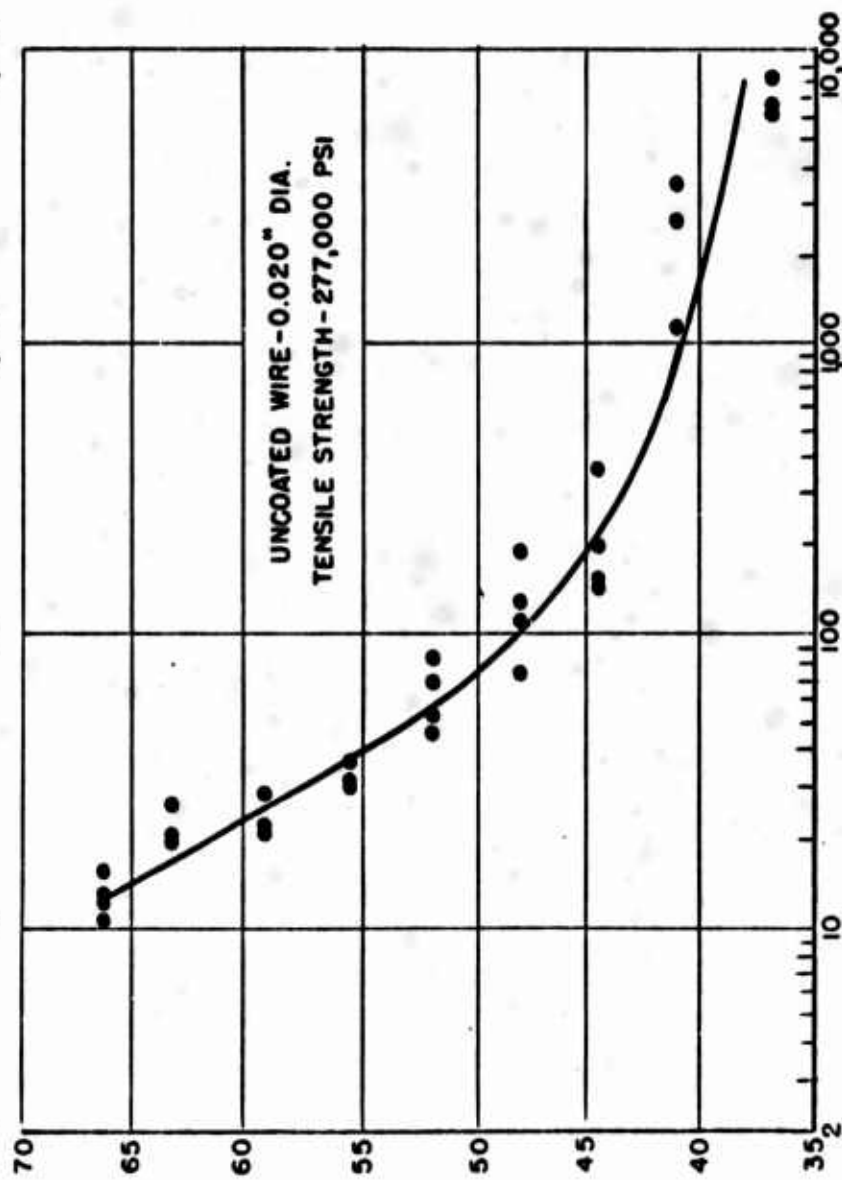
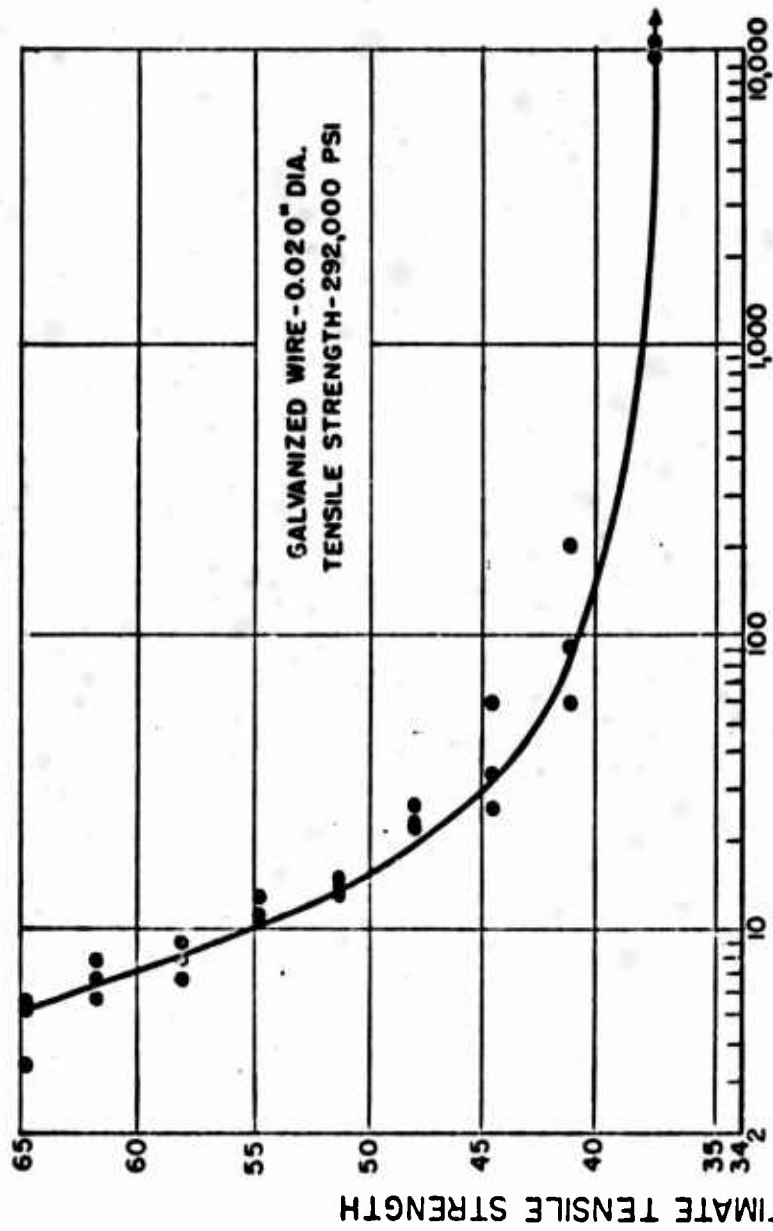


FIGURE 3 - RESULTS OF FATIGUE TESTS ON VARIOUS WIRE SPECIMENS

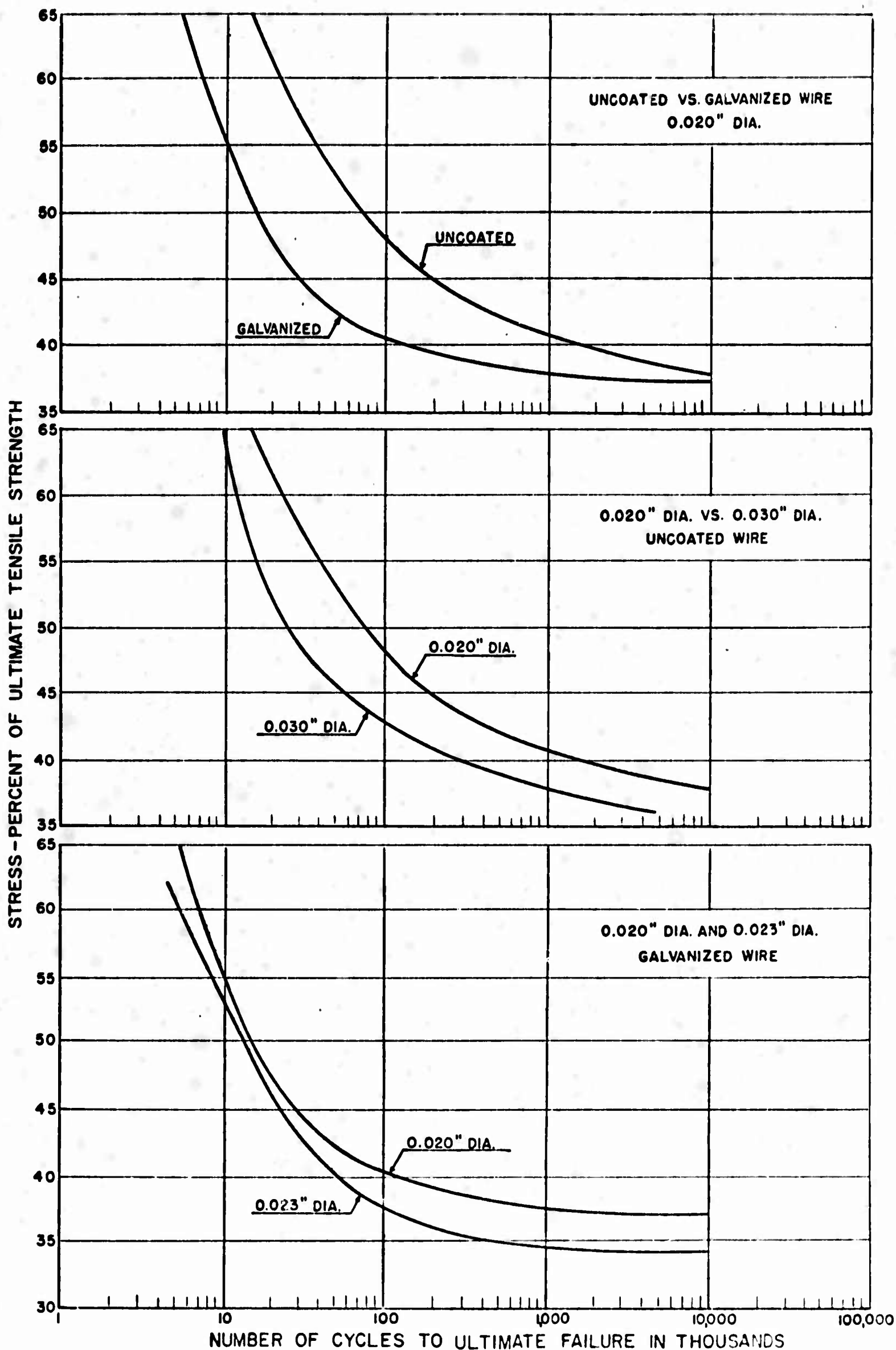


FIGURE 4 - COMPARISON OF S-N CURVES FOR VARIOUS WIRE SPECIMENS
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